inputs. A CPU may be used to perform the weight-and-sum operations or equivalent types of cancellation processes that result in separation of the signals. Although the invention is described with regard to RF and microwave frequencies, the principles of operation of the invention apply to any frequency in the electromagnetic spectrum. Additionally, a spatial demultiplexer may include combinations of space, frequency, time, and polarization-diversity combining methods. Furthermore, constant-modulus signals may be transmitted in the communication system. Constant-modulus transmissions can simplify the spatial demultiplexing of received signals. In this regard, it should be understood that such variations as well as other variations fall within the scope of the present invention, its essence lying more fundamentally with the design realizations and discoveries achieved than merely the particular designs developed.

The foregoing discussion and the claims that follow describe the preferred embodiments of the present invention. With respect to the claims, it should be understood that changes could be made without departing from the essence of the invention. To the extent such changes embody the essence of the present invention, each naturally falls within the breadth of protection encompassed by this patent. This is particularly true for the present invention because its basic concepts and understandings are fundamental in nature and can be broadly applied.

Sub A1

1. A method for spatial demultiplexing interfering signals comprising the steps of
   - transforming a discreet-time input signal into a plurality of spectral components,
   - computing a set of weights for each of a plurality of channels with respect to channel fading,
   - applying said weights to said spectral components, and
   - combining the weighted spectral components to cancel co-channel interference.

SUB B1

2. The method of claim 1 wherein the input signal is obtained by sampling at least one spread-spectrum signal.

3. The method of claim 2 wherein the input signal is obtained by sampling at least one received multicarrier signal.

4. The method of claim 2 wherein the input signal is obtained by sampling at least one code division multiple access signal.

5. The method of claim 1 wherein the input signal is obtained by sampling at least one discreet-time signal.

6. The method of claim 1 wherein the input signal is obtained by sampling at least one continuous-time signal.

7. The method of claim 1 wherein the discreet-time input signal is produced by sampling at least one received signal at a uniform sampling rate.

8. The method of claim 7 wherein the received signal passes through an anti-aliasing filter before being sampled.

9. The method of claim 1 wherein the discreet-time input signal is transformed into N spectral components using an N-point discreet Fourier transform.

10. The method of claim 9 wherein the step of transforming the discreet-time input signal into the plurality of spectral components includes a spectral filtering step in which only non-redundant spectral components are passed.

11. The method of claim 9 wherein the step of transforming the discreet-time input signal into the plurality of spectral components includes combining redundant spectral components.

12. The method of claim 1 wherein the weights are complex valued.

13. The method of claim 1 wherein the weights have time dependence related to changes in the fading environment.

14. The method of claim 1 wherein the weights are determined by a training sequence.

15. The method of claim 1 wherein the weights are determined by optimization.

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16. The method of claim 1 wherein the discreet-time input signal is received from a single antenna element.

17. The method of claim 1 wherein the discreet-time input signal is received from an antenna array.

18. The method of claim 1 wherein the discreet-time input signal is a multicarrier signal wherein each carrier of the multicarrier signal has a different spreading code and the step of transforming the discreet-time input signal into the plurality of spectral components includes a step of decoding the multicarrier signal.

19. The method of claim 1 wherein the discreet-time input signal is derived from at least two receive signals transmitted by at least one transmitter wherein the receive signals are transmitted with different beam patterns.

20. A method for spatial demultiplexing interfering signals comprising the steps of

Sub
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- transforming a discreet-time input signal that includes a plurality of interfering signals into a plurality of spectral components, the spectral components having differences in either or both amplitude variations and phase variations, and
- separating the interfering signals by processing either or both the amplitude variations and the phase variations of the plurality of spectral components.

21. The method of claim 20 wherein the step of transforming the discreet input signals includes a step of separating a plurality of interfering information signals modulated

on each of the spectral components and passing the information signals to the step of separating the interfering signals.

22. The method of claim 20 wherein the step of separating the interfering signals involves a constellation processing method.

23. The method of claim 20 wherein the discreet-time input signals are derived from a plurality of received signals, the received signals being transmit signals that have propogated in a free-space or guided-wave environment after being transmitted by a plurality of transmitters.

24. The method of claim 23 wherein each of the transmit signals has a different amplitude-versus-frequency profile.

25. The method of claim 23 wherein a plurality of the transmit signals have amplitude-versus-frequency profiles that are adjusted to provide unique amplitude-versus-frequency profiles to the received signals.

26. The method of claim 24 wherein at least two of the transmitters are co-located.

27. The method of claim 23 wherein the plurality of transmitters is an antenna array.

28. The method of claim 23 wherein at least two of the transmitters have different beam patterns.

29. The method of claim 28 wherein at least two of the transmitters are co-located.

30. The method of claim 23 wherein the transmit signals have constant modulus.

31. A method for spatial demultiplexing interfering signals comprising the steps of

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- transforming a receive signal that includes a plurality of interfering signals into a plurality of diversity components, the diversity components having differences in either or both amplitude variations and phase variations, and
- separating the interfering signals by processing either or both the amplitude variations and the phase variations of the plurality of diversity components.

32. The method of claim 31 wherein the diversity components are polarization-diversity components.

Sub B1

33. The method of claim 31 wherein the diversity components are frequency-diversity components.

34. In a spatial interferometry multiplexing (SIM) method wherein a plurality of received signals received from a plurality of transmit signals transmitted by at least one transmitter have spatial gain distributions, and differences in the spatial gain distributions of different received signals is exploited by the SIM process for separating interfering signals, a method for changing the spatial gain distribution of at least one of the received signals including the step of adjusting spatial gain distribution characteristics of at least one of the transmit signals.

Sub A4

35. An apparatus for spatially separating a plurality of interfering received signals, each of the received signals having a different amplitude-versus-frequency profile, the apparatus comprising
    - a diversity receiver for separating the received signals into a plurality of frequency components, and
    - a spatial demultiplexer for separating the received signals in the frequency components.

Sub B1

36. The apparatus of claim 35 wherein the diversity receiver includes a filter bank.

37. The apparatus of claim 35 wherein the diversity receiver includes a single antenna.

Sub A5

38. The apparatus of claim 35 wherein the spatial demultiplexer comprises
    - a weight generation unit for generating a plurality of weights based on the amplitude-versus-frequency profiles of the received signals, and
    - a combining unit for weighting and combining the plurality of received signals using the generated plurality of weights to enhance signal to interference of at least one of the received signal by canceling interfering signals.

39. The apparatus of claim 35 wherein the spatial demultiplexer separates received signals by comparing received signals to a constellation of points.